

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

July 14, 1846.—Wm. Yarrell, Esq., Vice-President, in the Chair.

Prof. Owen communicated, as an 'Appendix to his Memoir on the *Dinornis*,' some observations on the skull and on the osteology of the foot of the Dodo (*Didus ineptus*).

After a brief summary of the history of this remarkable extinct brevipennate Bird, in which the reduced highly finished figure by Savery, in his famous painting of 'Orpheus charming the Beasts,' now in the collection at the Hague, was particularly noticed; and the recent discovery of the skull of the Dodo amongst some old specimens in the Museum of Natural History at Copenhagen was mentioned, he proceeded to demonstrate the peculiarities of the Dodo's skull, by a comparison of the cast of the head of the bird in the Ashmolean Museum at Oxford with those of other recent and extinct species of Birds.

The Dodo's skull differs from that of any species of *Vulturidæ*, or any Raptorial Bird, in the greater elevation of the frontal bones above the cerebral hemispheres, and in the sudden sinking of the inter-orbital and nasal region of the forehead; in the rapid compression of the beak anterior to the orbits; in the elongation of the compressed mandibles, and in the depth and direction of the sloping symphysis of the lower jaw. The eyes of the Dodo are very small compared with those of the *Vulturidæ* or other *Raptores*. The nostrils, it is true, pierce the cere, but are more advanced in position; this however seems essentially to depend upon the excessive elongation of the basal part of the upper mandible before the commencement of the uncinate extremity; the nostrils are pierced near the commencement of this uncinate part as in the *Vulturidæ*, but are nearer the lower border of the mandible in the Dodo.

The resemblance between the skull of the Dodo and that of the Albatros is chiefly in the compression and prolongation of the curved mandibles: there are no traces in the Dodo of the hexagonal space on the upper surface of the cranium of the Albatros, so well defined there by the two supra-occipital ridges behind, the two temporal ridges at the sides, and the two converging posterior boundaries of the supra-orbital glandular fossæ in front. There is no sudden depression of the frontal region in the skull of the Albatros; the nostrils are near the upper surface of the basal third of the beak in the Albatros; and the Dodo's cranium is thrice as broad in proportion to the breadth of the mid-part of the mandible as in that of the Albatros.

More satisfactory evidence of the affinities of the Dodo was obtained from a comparison of the bones of the foot, which have recently been very skilfully and judiciously exposed by the able Curator of the Ashmolean Museum.

The tarso-metatarsal bone most resembles in its thickness and general proportions that of the Eagles, especially the great Sea-Eagles (*Haliaëtus*); it is much stronger than the tarso-metatarsus of

any of the *Vulturidae*, or than that of the Cock, the *Crax*, or any of the *Gallinæ* or existing *Struthionidæ*; the stronger-footed species of *Dinornis* most resemble it in the general proportions of the tarso-metatarsus, but greatly differ in the particular configuration of the bone, and in the absence, or feebler indication, as in the subgenus *Palapteryx*, of the articulation for the metatarsal bone of the back-toe. The relative size of this bone is greater in the Dodo than in any other known bird. The Eagles make the nearest approach to it in this respect; as also in the shape of the hinder supplemental metatarsal, the breadth of its distal end, and its peculiar twist backwards and outwards, so as to form a bridge or pulley against which the flexor tendon of the hind-toe plays. This half-twist of the rudimentary hind-metatarsus is feebly repeated in the *Gallinæ*, but the bone is much less expanded at its lower articular end, especially in the *Crax*; whilst the more typical *Gallinæ* are further distinguished from the Dodo by their spur.

The Apterix is the sole existing Struthious bird which possesses the hind-toe; but it is very much smaller than in the Dodo, and the supporting metatarsal bone is devoid of the distal twist and expanded trochlea. The upper end of the tarso-metatarsus of the Dodo is remarkable for the great development of its calcaneal process, from which a strong ridge descends, gradually subsiding, half-way down the bone. The posterior surface of the calcaneal process is broad, triangular, vertically grooved and perforated at its base. In the Eagle the corresponding calcaneal process is a compressed, subquadrate ridge, whose base of attachment is not much longer than the obtuse end, and this is neither grooved nor perforated. In the *Cathartes Californianus* the calcaneal process is thicker than in the Eagle, shaped more like that of the Dodo, with a ridge descending upon the metatarsus, but it has a double groove behind.

In the Common Cock the calcaneal process more resembles that in the Dodo than the Vulture's does, but it is not so broad.

With regard to the first or proximal phalanx of the hind-toe, that of the *Haliaëtus* is larger and broader, especially at its base, stronger in proportion to its length, but longer in proportion to the sustaining metatarsus.

In the Vultures the proximal phalanx is not only longer in proportion to the metatarsus, but is more slender than in the Dodo. The same bone is also longer and more slender in proportion to the small supporting metatarsal bone in the Cock, the *Crax*, and all other *Gallinæ*; in fact, the Dodo is peculiar among Birds for the equality of length of the metatarsus and proximal phalanx of the hind-toe. With regard to the three trochlear extremities of the principal coalesced metatarsals, the middle one in all *Gallinæ* is longer in proportion than in the Dodo, in which the inner one is nearly as long as the middle one, the outer one being the shortest. In the Eagle the inner division is of quite equal length with, or is longer than the middle trochlea; the proportions of the three trochleæ in the Vultures corresponding best with those in the Dodo. Another character by which the Dodo resembles the Vulture more than the Eagle is

manifested by the proportions of the proximal phalanx of the second toe (innermost of the three anterior ones); this is very short, and is often ankylosed to the second phalanx in the Eagles: it is almost as long in the Vultures as in the Dodo.

Upon the whole, then, the Raptorial character prevails most in the structure of the foot, as in the general form of the beak, of the Dodo, compared with Birds generally; and the present limited amount of our anatomical knowledge of the extinct terrestrial Bird of the Mauritius would lead to support the conclusion that it is an extremely modified form of the Raptorial Order.

Devoid of the power of flight, it could have had small chance of obtaining food by preying upon the members of its own class; and if it did not exclusively subsist on dead and decaying organized matter, it most probably restricted its attacks to the class of Reptiles, and to the littoral fishes, Crustacea, &c.

The author concluded by recommending search to be made for bones of the Dodo in the superficial deposits, the alluvium of rivers, and the caves in the islands of Mauritius and Rodriguez; little doubting that an active exploration would be as richly rewarded as similar investigations have been in the islands of New Zealand, by the recovery of the remains of the great extinct species of terrestrial birds which formerly inhabited them.

August 25.—R. C. Griffith, Esq., in the Chair.

The following communication was read:—"On the Relation of the *Edentata* to the Reptiles, especially of the Armadillos to the Tortoises." By Edward Fry.

The dissections of two specimens of Tortoise, of which I have been unable to recognise the species with certainty, induced me to believe that those animals are allied to the Armadillos. Continuing this investigation, and extending it to the *Edentata* in general, I arrived at the conclusion that they are allied to the Reptiles. As some points of affinity have occurred to me which I have not seen noticed as such, I believe that a short sketch of the subject may not be devoid of interest; and as Professor Owen has intimated his belief that the *Edentata* are allied to Birds rather than to any other class, I shall conclude my paper with a consideration of the arguments adduced by him hereon.

Such subjects as the one I shall attempt to investigate are of so high an interest to the zoologist, that any one contributing in the least degree to elucidate them may hope for indulgence.

I regret not being able to ascertain the names of the species of Tortoise which came under my notice, but trust that this omission will not materially deduct from the interest of the subject.

Sect. I. *Of the Relation of the Genera Dasypus and Testudo.*

1. In the Tortoise the oesophagus is large and muscular, admitting bodies of great size in proportion to the mouth. From the structure of the mouth it is incapable of masticating the food, whence arises the necessity of a large and muscular oesophagus. Professor Owen has remarked a similar structure, and adduced the same final cause

in the Armadillo, *Dasypus peba*. In his paper in the Proceedings of the Zoological Society, i. 144, he says: "The muscular parietes of the pharynx and oesophagus are very thick, for from the nature of the teeth, small, conical and wide apart, the food can undergo but little comminution in the mouth, and hence the necessity of additional power for propelling imperfectly divided substances into the stomach."

2. In concordance with the structure of the mouth, the stomach of the Tortoise is strong and muscular: in the larger of the two individuals I dissected so remarkably so, as would forcibly have reminded a casual observer of the gizzard of birds. The stomach of the Armadillos, though of a globular form, is similar in structure; so much so, that Prof. Owen speaks of it as "a structure analogous to the gizzard of birds," *Ibid.* As in the *Dasyopodæ* (Zool. Proc. i. 142 & 154), so in the larger specimen of the Tortoise, the coats of the stomach, generally thick, are especially so at the pylorus.

3. In the smaller species of Tortoise I observed that the colon is prolonged beyond the insertion of the ileum, so as to form a short cæcum, as described by Martin in his account of the *Testudo græca* (Zool. Proc. i. 63 & 74). In my larger species there was no cæcum; such is also the case with the *Testudo indica* (Zool. Proc. i. 47). In the *Testudo tabulata* "there is no trace of appendix cæci" (Holberton in Zool. Journal, iv. 325). On the other hand, Prof. Owen has ascertained the presence of a cæcum in another species of Tortoise, *Emys concentrica*, Leconte (Zool. Proc. i. 74). From these accumulated observations, it becomes evident that the presence of a cæcum is a varying character in the Tortoises. A similar variability in this structure has been remarked by Prof. Owen in the genus *Dasypus* (Zool. Proc. i. 156).

4. A great tendency to ankylose parts usually distinct, and to ossify others generally cartilaginous, is observable in the Tortoise in the ribs, in the dorsal vertebræ, in the scapulæ and clavicles, in the component parts of the pelvis, in the sternal cartilages, and in the parts forming the plastron. In the Armadillos it may be remarked in the cervical vertebræ, in the sternal portions of the ribs, and in the manubrium and clavicular processes (Owen in Zool. Proc. ii. 134). In the Sloths also it is especially evident in the ankylosis of the bones of the hand.

5. Hence results a similarity of locomotion in the Tortoises and Armadillos; so that the following extract from Prof. Owen, referring to the motion of the latter animals, will apply almost equally well to that of the former: "Every one who has seen the living Armadillo running about the open plot of ground in the Society's Gardens must have been struck with the machine-like manner in which the body is carried along. The short legs are almost concealed, and their motions are not accompanied by any corresponding inflections of the spine, the two extremities of the trunk not being alternately raised and depressed as in the quadrupeds which move by bounds" (Zool. Proc. ii. 135).

6. The anterior articular processes of the vertebræ of the Armadillo, especially of the hinder dorsal and the lumbar regions, assist as

"strutts or braces" in the support of its heavy shell; whilst in the Tortoise a similar object is effected by the small osseous supports which proceed from its ankylosed spine.

7. Both in the Armadillo and Tortoise the ossa ilia appear to serve as additional supports to the shell.

Sect. II. *Of the Relation of the Edentatous Mammalia to the Reptiles.*

1. In the Two-toed Anteater the ribs are so broad as to overlap each other like tiles (Cuvier, Lectures on Comparative Anatomy, translated by Ross, 1802, vol. i. p. 209). This is, I believe, the nearest resemblance amongst other Vertebrata to the bony case of the Tortoises. In the Armadillo the first pair of ribs are broader than they are long (Owen, Zool. Proc. ii. p. 135).

2. In the large number of the ribs of the Unau, we have what Prof. Owen has termed a lacertine character (on Mylodon, p. 166).

3. Like the Tortoises, &c. amongst Reptiles, the Anteaters and Pangolins are deprived of teeth; whilst those Edentata which are furnished with them approximate to the dentition of some of the Reptilia in the uniform character of the series; and in the subgenus *Priodontes* of Fred. Cuvier in the extremely large number, namely eighty-eight or ninety-six in all.

4. The Edentata, like the Reptiles, are remarkable for the propensity to develope coats of mail of various kinds; sometimes continuous; in other instances, of detached and separate scales; sometimes, to continue the simile, like plate-armour; sometimes like scale-armour. The Armadillos, the Chlamyphorus, the Pangolins, and some of the extinct Megatheroids, exhibit this amongst the Edentates; whilst almost all the Reptiles partake in measure of this character.

5. The Anteater and Manis are destitute of the power of emitting sounds (Blumenbach's Anatomy, translation by Lawrence, 1807, p. 278). This incapacity approximates them to the Reptiles, and particularly distinguishes them from Birds and most of the Mammalia. In this character however most of the Marsupiata partake.

6. Waterton, in his 'Wanderings,' furnishes us with a highly graphic description of the habits of the *Myrmecophaga jubata*. From the extracts I shall make, the similarity of this animal to the Reptiles will be manifest in three important points, viz. the slowness of its movements, the tenacity with which it retains any object which it has seized, the length of time which it can pass uninjured without food; and probably a fourth—the tenacity of life and muscular power. The Tortoises exhibit these phenomena of muscular irritability perhaps as well as any genus amongst the Reptiles.

"He (*Myrmecophaga jubata*) cannot travel fast, for man is superior to him in speed. . . . Whenever he seizes an animal with these formidable weapons (his claws), he hugs it close to his body and keeps it there till it dies through pressure or through want of food. Nor does the Antbear in the meantime suffer much from want of aliment, for it is a well-known fact that he can go longer without food than

any other animal, excepting perhaps the Land Tortoise. The Indians have a great dread of coming in contact with this animal, and after disabling him in the chase, never think of approaching him till he is quite dead." (Waterton's Wanderings in South America, 171.)

That muscular irritability exists to a similar extent in the Sloths will be proved by the following extract:—

"Cor motum suum valdissime retinebat postquam exemptum erat a corpore, per semihorium; exempto corde, ceterisque visceribus multo post se movebat et pedes lente contrahebat sicut dormituriens solet." (Pison. Hist. Bras. p. 322, quoted by Buffon; translation by Smellie, 1791, vol. vii. p. 161.)

7. In the Sloths and Weasel-headed Armadillo the absence of the os tincæ, and the consequent formation of a single tube by the uterus and vagina, approximate these organs very nearly to the oviduct of the Reptilia (see Owen, Zool. Proc. ii. 131, and on the Generation of Marsupial Animals in Phil. Trans. 1834, p. 365).

In the genera *Bradypus*, *Dasypus*, *Manis* and *Myrmecophaga*, "the utero-sexual canal," to use the words of the last-quoted memoir, "is formed, as in the Tortoises, by a continuation of the urethra or urinary bladder, into which the genital tube opens by a small orifice."

8. There is yet another highly important character, one indeed which has probably a relation to the preceding, which displays the intimate relationship of the Edentata and Reptiles, namely the extreme simplicity of the brain. In the Armadillos, Manises and Ant-eaters, the cerebral hemispheres are devoid of convolutions, whilst in the Sloth they present a few anfractuosities (Owen, Phil. Trans. 1834, p. 361).

9. Professor Owen says, in his elaborate memoir on the *Mylodon robustus*, that the presence of a persistent formative organ of the teeth of the Megatheroids indicates a property in which they resembled the Reptiles, viz. longevity (p. 166). And again, the intimate structure of the soft dentine of the teeth of the Iguanodon resembles that of the extinct Megatherium and of the recent Sloths (Owen's Odontography, p. 251). Is it not an idea which forcibly impresses on us the unity of the great plan of nature, that had a comparative anatomist existed in the days of the Megatherium and Iguanodon, he might have discovered from an examination of their teeth two common characters, and might thence perhaps have inferred those very relations which in the present paper I have been seeking to enforce with regard to their congeners of another age—almost another world?

10. It is well known that the blood-corpuscles of the Reptiles are remarkably large; the Sloths are the largest yet known amongst the Mammalia, with the single exception of the Elephant. Perhaps however this may be a character of little importance in elucidating the natural affinities of groups, as we find the corpuscles of the Armadillo rather smaller than Man's, and those of the Monotremata of about the same size as the human (Gulliver on Blood-corpuscles, Zool. Soc., October 14, 1845).

Sect. III. *Of the Arguments adduced by Professor Owen for believing the Edentata to be allied to Birds.*

I propose first to enumerate these arguments, and then to consider them more particularly. They are to be found in Professor Owen's interesting papers on the anatomy of the Six-banded and Weasel-headed Armadillos in the Proceedings of the Zoological Society of London, so often referred to and quoted in this paper, and are as follows :—1. The presence of two cæca in the *Dasypus 6-cinctus* and *Myrmecophaga didactyla*. 2. "The gizzard-like structure exhibited in the tendinous external appearance and thickened muscular coat of the stomach of the *Dasypoda*," and a still nearer approach in the stomach of the Manis. 3. The presence of a similar structure in the Myrmecophagæ, accompanied by the habit of swallowing small pebbles for the purpose of destroying the vitality of the insects which form their food. 4. The similarity of the mucous glands about the os hyoides of the Anteaters to those follicles in the Woodpeckers, which represent amongst Birds the conglomerate salivary glands of the Mammalians; and the lubrication of the extensile tongue. 5. The abnormal number of cervical vertebræ in the Three-toed Sloth. 6. Prof. Owen concludes this line of argument in the following words: "The transition is indeed nearly completed by the Monotremata, for of the two genera contained in this order, *Echidna* presents us with the quills, and *Ornithorhynchus* with the beak of a bird; and it is far from being proved that the mode of generation is not the same." 7. The form of the pubis of the Armadillo indicates "that only a small portion of what usually constitutes the symphysis is here joined to its fellow, viz. the anterior angle;" and in *Chlamyphorus* and *Myrmecophaga didactyla* the ossa pubis remain entirely separate, as is the case in Birds. The pelvis likewise resembles theirs "in the great breadth of the posterior part of the sacrum, the angles of which are ankylosed to the spines of the ischia, and convert the great ischiatic notches into complete foramina."

1. The occurrence of double cæca is a remarkable point of affinity to Birds; but we have previously shown that the presence of cæca is a variable character in the Tortoises, as in both *Dasypus* and *Myrmecophaga*, so that the characters furnished us by this organ seem to approximate them equally to Birds and Reptiles.

2. We have shown the structure of the stomach in the Tortoises to be gizzard-like. This is also the case in *Crocodilus acutus* (Owen in Zool. Proc. 1830, p. 139). Hence the stomach of the Edentata presents us with an equal analogy to Reptiles and Birds.

3. The habit of the *Myrmecophaga* of swallowing small pebbles to increase the trituration of the gizzard, is certainly analogous to that of the Gallinaceous Birds. But the same has been remarked in the Egyptian Crocodile by Professor Geoffroy St. Hilaire, and in the sharp-nosed species by Prof. Owen (*ubi supra*). As the gizzard-like structure and pebbles of the *Myrmecophaga* are adapted to the digestion of animal food, as in the *Reptilia*, and not of vegetable, as in the Gallinaceous Birds, I consider the resemblance of the Edentata in these respects to be greater to the former than the latter animals.

4. The salivary glands of the Chameleon, if not formed on exactly the same type as those of the Anteaters, are at least similar in the office they perform.

5. The abnormal number of cervical vertebræ in the Ai approximates the Edentata equally to Reptiles and Birds.

6. The Monotremata, which Professor Owen in the passage I have quoted seems to look upon as the terminal link between the Edentata and Birds, are certainly more nearly allied to Reptiles than to Birds, and have indeed been considered so by himself, as will be manifest from the following extract from a letter of that gentleman quoted in Kirby's Bridgewater Treatise, vol. ii. p. 432 :—"Dissections of most of the genera of Marsupians have tended to confirm in my mind the propriety of establishing them as a distinct and parallel group, beginning with the Monotremes, which I believe to lead from Reptiles, not Birds." Again, in his paper 'On the Young of the *Ornithorhynchus paradoxus*,' Zool. Trans. vol. i. p. 221, he very distinctly states the weight of evidence to be in favour of the relation of the Monotremates to the Reptiles rather than Birds; so that in all probability he has altered his views on this subject since 1830.

The evidence produced above is conclusive for my purpose, and precludes the necessity of discussing the analogies of the Monotremata. But as Prof. Owen has alluded to the beak of the Ornithorhynchus as that "of a bird," it may not be irrelevant to show in how many important particulars the two structures differ. "This structure," says Sir Everard Home, speaking of the organ in question, "differs materially from the bill of a Duck, and indeed from the bill of all birds, since in them the cavities of the nostrils do not extend beyond the root of the bill; and in their lower portions, which correspond to the under jaw of quadrupeds, the edges are hard, to answer the purpose of teeth, and the middle space is hollow, to receive the tongue" (Home on Head of Ornithorhynchus, Phil. Trans. 1800). When to this diversity of structure we add the difference of use, we shall see that however strong may be the resemblance at first sight, it is perhaps more imaginary than real. From the description above-quoted, we learn that the beak of the Ornithorhynchus is incapable, from the general flexibility of its structure, of taking firm hold of any object; but that the marginal lips being brought together, the prey is sucked into the mouth.

Perhaps too the similarity of the spines of the Echidna to the quills of a bird is not very close.

7. The pelvis of some Edentata certainly resembles that of Birds in a remarkable degree.

I have thus endeavoured to show that many of the structures in the Edentata, adduced by Prof. Owen as offering relations to Birds, are equally so to Reptiles; whilst those that lead us to the former class are not of equal number or importance to those that conduct us to the latter.

I am fully aware that the scope and conduct of my investigations have been defective; but so far as they extend they appear to me to

prove simply this, viz. that the Edentata are allied to the Reptiles, and that more nearly than to Birds.

It would have been absurd to expect any other result from this investigation than such as the present: a group is never related to one other group only: "The true affinities of organic structures branch out irregularly in all directions."

I cannot conclude without observing, that it is highly remarkable and interesting that affinities should be found to prevail amongst creatures often remotely situated one from the other in the Animal Kingdom; that these relations often appear subtle and irrespective of functional similarity; and that whilst their final cause will probably ever remain unknown to man, we cannot consider them without deeply appreciating the order, the unity and dependence which prevail throughout all parts of nature.

EDW. FRY.

MISCELLANEOUS.

A new genus of Sea-Snake from Port Essington.

By J. E. GRAY, F.R.S.

THE snake here described formed part of the extensive collection brought home by Mr. Jukes, the naturalist to H.M.S. Fly. It is remarkable as having the compressed shape, the short blunt head, the peculiar lunate valvular nostrils on the upper surface of the nose, the small superior eyes, the head-shields and the compressed tail of *Hydrus*, but differs from it in having large polished smooth keelless scales, and the broad band-like ventral shields of the vermiciform terrestrial snakes (*Elaphina*). In this respect it agrees with the genus *Aipisurus*, but it is at once distinguished from that genus by the ventral shields being broader in proportion and acutely keeled along the middle line, and by having the head-shields of *Hydrus*; in fact it is exactly intermediate between the genus *Hydrus* of *Hydridæ* and *Aipisurus* of *Elaphidæ*. It may be called *HYPOTROPIS*.

Scales large, smooth, six-sided; head short, truncated in front; nasal large, with the lunate nostrils in the middle of their hinder part; crown shields small, superciliary numerous, labial shield high, loreal none; throat scaly; ventral shields broad, band-like, folded together and keeled in the middle, notched behind at the keel; tail compressed, covered with large broad six-sided smooth scales.

Hypotropis Jukesii. Olive, yellowish below.

Hab. Sea, near Darnley Islands. "Merad sand-bank, while at anchor, May 1845."

On the Pulmograde Medusæ of the British Seas.

By Prof. E. FORBES*.

At the Birmingham Meeting in 1839, the author, in conjunction with Prof. Goodsir, brought forward a first essay towards an investigation of the British Acalephæ, selecting the ciliograde species for illustration. Since that time he has yearly availed himself of every opportunity of pursuing the inquiry, but has abstained from publish-

* Read at the Southampton Meeting of the British Association.